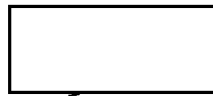


AP-2

AP DEVELOPMENTS



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16 Apr 62

STATINTL

[REDACTED] HAS JUST PRECEDED ME ON THIS PLATFORM, HAS DISCUSSED SOME OF THE AP/1 CHARACTERISTICS. WE REGRET THAT DUE TO THE TESTING PROGRAM AND TIME LOSS INVOLVED WE COULD NOT EXHIBIT THE AP/1 HERE THIS WEEK AT THE CONGRESS.

STATINTL

MY PURPOSE TODAY IS TO TELL YOU ABOUT OUR LATEST MODIFICATIONS TO THE AP/1. THE AP/1 IS EFFECTIVELY A PROTOTYPE OF OUR INITIAL CONCEPTS. THE SUCCESS OF ITS REALIZATION ENCOURAGED US (AND BY US I MEAN ALL PARTIES CONCERNED WITH THE PROJECT, NAMELY, USAF [REDACTED] TO GO AHEAD WITH AN ADVANCED SECOND GENERATION PROTOTYPE WHICH WE UNIMAGINATIVELY CALLED THE AP/2.

STATINTL

THE AP/2 IS A MORE SOPHISTICATED, MORE GENERAL PURPOSE AND LOGICALLY MORE EXPENSIVE VERSION OF THE AP/1. PHYSICALLY THE TWO TYPES APPEAR TO BE QUITE SIMILAR TO EACH OTHER. THE COMPUTER IS ONE-THIRD LARGER, THE CONTROL PANEL HAS MORE CONTROLS ON IT AND THE OPTICAL SYSTEM IS SOMEWHAT DIFFERENT IN APPEARANCE. IN OTHER PHYSICAL RESPECTS THEY MORE OR LESS PRESENT THE SAME GENERAL ASPECT.

SPECIFICALLY THE TWO PLOTTERS VARY AS FOLLOWS. IN THE AP/1 THE INTERIOR ORIENTATION IS MADE BY THE OPERATOR READING OUT THE COORDINATES OF EACH FIDUCIAL MARK AND THEN COMPUTING AND ENTERING INTO THE COMPUTER MEMORY THE CENTER OF GRAVITY OF THESE MARKS. THIS IN EFFECT LOCATES THE MEAN POSITION OF THE PRINCIPAL POINT. THE AP/2 VERSION IS MATHEMATICALLY THE SAME BUT IS MORE AUTOMATIC. THE OPERATOR ALIGNS HIS MARK ON EACH FIDUCIAL BUT THE COMPUTER KEEPS TRACK OF EACH OBSERVATION AND COMPUTES AND ENTERS INTO THE MEMORY AUTOMATICALLY THE POSITION OF THE PRINCIPAL POINT.

FOR RELATIVE ORIENTATION ON THE "1" IN THE SEMI-AUTOMATIC LEAST SQUARES SOLUTION, THE OPERATOR CAN ONLY MAKE USE OF THE SIX CLASSICAL POSITIONS FOR CLEARING Y PARALLAX IN THE STEREOMODEL. WITH THE "2" THE OPERATOR HAS THE OPTION OF USING 6, 9 OR 12 LOCATIONS FOR ELIMINATING Y PARALLAX THUS OBTAINING, IF SO DESIRED, A MORE RIGOROUS SOLUTION.

ABSOLUTE ORIENTATION WITH THE "1" IS ESSENTIALLY TRIAL AND ERROR, ALTHOUGH GREATLY FACILITATED BY THE POSSIBILITY OF READING DIRECTLY THE MODEL DISTANCE BETWEEN ANY TWO POINTS. WITH THE "2" ABSOLUTE ORIENTATION IS A LEAST SQUARES SOLUTION WHERE MODEL COORDINATES OF CONTROL POINTS ARE COMPARED WITH TRUE SCALE MODEL COORDINATES WHICH ARE ALREADY IN THE COMPUTER AND PROPER CORRECTIONS ARE INDICATED FOR ALL MODEL PARAMETERS TO EFFECT A LEAST SQUARES SOLUTION.

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IT IS EXPECTED THAT THESE IMPROVEMENTS ON THE ORIENTATION CAPABILITIES OF THE STEREO PLOTTER WILL GREATLY INCREASE THE SPEED OF THE ORIENTATION PROCESS AND ALSO SERVE TO PRODUCE A MORE STATISTICALLY ACCURATE AND REPEATABLE ORIENTATION.

AS INTERESTING AND DESIRABLE AS THE INNOVATIONS ARE WHICH HAVE JUST BEEN DESCRIBED, THE MOST SIGNIFICANT CHANGE HAS BEEN IN MAKING THE AP/2 COMPLETELY UNIVERSAL AS TO TYPE OF PHOTOGRAPHY WHICH CAN BE ACCOMMODATED.

THE AP/1 CAN ACCOMMODATE PHOTOGRAPHS WITH TILTS UP TO NINE DEGREES. THE AP/2 CAN ACCOMMODATE AERIAL EXPOSURES WITH TILTS AS HIGH AS 45 DEGREES OR A CONVERGENT ANGLE BETWEEN PHOTOS OF 90 DEGREES. IT IS POSSIBLE WITH THE AP/2 TO HANDLE ANY TYPE OF AERIAL STEREOSCOPIC COVERAGE NOW IN USE OR NOW BEING CONTEMPLATED FOR USE IN THE FORESEEABLE FUTURE.

TO ATTAIN THIS ADDITIONAL CAPABILITY CERTAIN CHANGES TO THE AP/1 WERE NECESSARY.

THE DIGITAL COMPUTER HAD TO BE SUBSTANTIALLY ENLARGED, ABOUT 30 PERCENT, TO HANDLE THE INCREASED COMPUTATIONAL LOAD. THE OPERATOR'S CONTROL PANEL HAD TO BE EQUIPPED WITH ADDITIONAL CONTROL ELEMENTS TO REFLECT THE INCREASED OPERATIONAL PARAMETERS INVOLVED.

IMPORTANT AND RADICAL CHANGES WERE MADE TO THE OBSERVATIONAL OPTICAL SYSTEM. IN VIEW OF THE REQUIREMENT FOR ACCOMMODATING PHOTOGRAPHS WITH RELATIVELY HIGH DEGREES OF TIP AND TILT, THE OPTICAL SYSTEM WAS REDESIGNED TO HAVE INDEPENDENT CONTINUOUSLY VARIABLE MAGNIFICATION FOR EACH OCULAR. CONTROL OF THE MAGNIFICATION OF EACH EYEPIECE IS EXERCISED BY THE COMPUTER BY MEANS OF SERVO MOTORS. ALSO THE AZIMUTH OF THE IMAGE FIELD IS ALSO CONTROLLED BY THE COMPUTER THROUGH SERVO MOTORS WHICH ROTATE AMICI PRISMS IN THE OPTICAL TRAIN. NATURALLY THESE COMPUTER CONTROLLED MOTIONS CAN ALSO BE MANUALLY OPERATED WHEN DESIRED.

THE OBJECT IN HAVING THE OPTICAL SYSTEM CONTROLLED BY THE COMPUTER IS TO PRESENT AT ALL TIMES TO THE OPERATOR AN EASILY FUSIBLE STEREO IMAGE REGARDLESS OF THE TILTS OF THE INDIVIDUAL PHOTOS COMPRISING THE STEREO PAIR. THE COMPUTER IS ALWAYS AWARE OF THE PHOTO COORDINATES OF THE PICTURE POINT BEING OBSERVED. HAVING THE TILT VALUES IN ITS MEMORY, IT IS RELATIVELY STRAIGHT FORWARD TO COMPUTE THE MAGNIFICATION AND ROTATION REQUIRED FOR THE IMAGE IN QUESTION AND TO EFFECT IT.

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AN ADDITIONAL IMPORTANT CHANGE IS THE ELIMINATION OF MECHANICAL DIFFERENTIAL GEARING USED IN THE AP/1 PROTOTYPE AND SUBSTITUTING FOR IT ELECTRONIC DIFFERENTIAL CONTROL. IN THE AP/1 THE RAW PHOTO COORDINATES INITIATED BY THE OPERATOR ARE COMBINED WITH THE COMPUTER CALCULATED CORRECTIONS BY MEANS OF TWO ROTATING SHAFTS JOINING IN A MECHANICAL DIFFERENTIAL AND YIELDING A RESULTANT SHAFT MOTION. ALTHOUGH THIS WAS FOUND TO BE A SUCCESSFUL AND ACCEPTABLE SOLUTION, AN EVEN MORE DESIRABLE SYSTEM IS USED ON THE AP/2 WHERE THE RAW PHOTO COORDINATE VALUES ARE DIGITALLY COMBINED WITH CORRECTIONS THUS ELIMINATING THE REQUIREMENTS FOR A MECHANICAL DIFFERENTIAL SYSTEM. THIS NOT ONLY SIMPLIFIES THE MECHANICAL DESIGN OF THE PLOTTER BUT ALSO PERMITS A POTENTIALLY HIGHER ACCURACY.

ANOTHER SIGNIFICANT ADVANTAGE GAINED BY THE ELIMINATION OF THE MECHANICAL DIFFERENTIAL IS THE DIRECT CONTROL OF THE COORDINATOGRAPH THROUGH THE DIGITAL COMPUTER. THIS CHANGE OFFERS INTERESTING POSSIBILITIES TO THE ANALOGUE OUTPUT OF THE PLOTTER SYSTEM.

STATINTL

WE CONSIDER THE AP/2, AS WE DO THE AP/1, TO BE NOT A STEREOPLOTTER BUT A STEREOPLOTTING SYSTEM. IT IS MUCH MORE ELASTIC IN CONCEPT AND DESIGN THAN A CONVENTIONAL ANALOGUE STEREOPLOTTER. CHANGES IN CAPABILITIES CAN BE ACCOMPLISHED TO MEET THE USERS REQUIREMENTS WITH RELATIVE EASE AS COMPARED WITH ANALOGUE INSTRUMENTS. IN COOPERATION

MODIFIED THE AP/1 AND PRODUCED THE AP/2 WHICH WE FEEL MARKS A PLATEAU OF EFFORT AT WHICH THE SYSTEM CAN BE STANDARDIZED FOR PRODUCTION. WE DO NOT OVERLOOK THE POSSIBILITY THAT SOME USERS MAY DESIRE EVEN FURTHER SOPHISTICATION - HOWEVER, WE ARE PERFECTLY WILLING TO IGNORE SUCH POSSIBILITIES UNLESS REQUESTED FOR WE TRULY FEEL THE AP/2 IS ADEQUATE FOR ALL REQUIREMENTS AT THIS TIME.

MY PRESENTATION WOULD NOT BE COMPLETE IF I DID NOT MENTION THAT WE ARE CERTAINLY WELL AWARE THAT THE AP/1 AND AP/2 SYSTEMS WERE DESIGNED PRIMARILY TO MEET VERY GENERAL AND UNIVERSAL REQUIREMENTS OF GOVERNMENTAL AGENCIES - AND AS A RESULT ARE VERY SOPHISTICATED SYSTEMS.

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WE HAVE NOT FORGOTTEN THE SPECIAL PROBLEMS AND REQUIREMENTS OF COMMERCIAL ORGANIZATIONS AND OTHER GROUPS OPERATING WITH CLASSICAL CONVENTIONAL AERIAL PHOTOGRAPHY. WE ARE ACTIVELY STUDYING AT THIS TIME AN AP SYSTEM DESIGNED FOR SUCH USERS. WE HOPE IN THE RELATIVELY NEAR FUTURE TO ARRIVE AT SUCH SYSTEM WHICH WILL BE EXTREMELY INTERESTING TECHNICALLY AND ALSO ECONOMICALLY.

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